View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by Repositório da Universidade dos Açores

WORKING PAPER SERIES

CEEAplA WP No. 01/2011

Estimating the Impacts of Eliminating Fisheries Subsidies on the Small Island Economy of the Azores

Mário Fortuna
Natacha Carvalho
Sameer Rege

January 2011

Universidade dos Açores
Universidade da Madeira

Estimating the Impacts of Eliminating Fisheries Subsidies on the Small Island Economy of the Azores

Mário Fortuna
Universidade dos Açores (DEG e CEEAplA)

Natacha Carvalho
Universidade dos Açores (DOP)

Sameer Rege
Universidade dos Açores (DEG e CEEAplA)

Working Paper n.º 01/2011
Janeiro de 2011

CEEAplA Working Paper n.º 01/11
Janeiro de 2011

RESUMO/ABSTRACT

Estimating the Impacts of Eliminating Fisheries Subsidies on the Small Island Economy of the Azores

Subsidies that reduce the costs incurred by fishers and increase profits for the industry can insulate fishers from economic signals, countering the economic incentive to stop fishing when it is unprofitable. Subsidies can thus be a major impediment to achieving economically productive fisheries, exacerbating overexploitation and delaying the necessary industry adjustments, particularly in the absence of effective management systems. Although some fisheries are profitable without government support, several studies have shown that many European fishing fleets are either running losses or returning low profits. In most cases operating costs are higher than gross revenue, resulting in a negative net contribution of fisheries to the economy, the deficit of which is largely funded by subsidies. Thus the cost of fishing to the public budget exceeds the total value of the catches. Recently, fishery subsidies have received much attention with a mounting literature on the urgent need to reduce capacity-enhancing subsidies and begin focusing on developing a profitable and sustainable industry that can adapt to changing economic and environmental conditions. Simple economic models showing how subsidies affect profits and therefore provide incentives for increased fishing effort have accompanied a number of overviews of subsidies published by leading intergovernmental and research institutions. A number of case studies have also illustrated the critical link between fleet capacity and subsidies and that some categories of subsidies are more distorting than others. However, most of the studies have been limited to estimating the value of these subsidies, and usually at the multinational or global level. None so far, to our knowledge, has estimated the economy-wide impact of reducing or eliminating fishing subsidies even though there is a growing consensus that subsidies should gradually be terminated. Moreover, the Fisheries Secretariat believes that capacity enhancing and fuel subsidies should be stopped immediately. Nonetheless, the new financial instrument of the CFP, the European Fisheries Fund (EFF 2007-2013), although an improvement on its previous homologous (FIFG 2000-2006), contains some ambiguous elements, which could open up for further increase of fishing capacity. A long-term approach is needed that encompasses more fundamental changes than using for example more efficient engines that initially reduce fuel consumption but in the long-run worsen the situation by contributing to increasing fishing effort on already overexploited stocks. On account of the global fisheries crises, highly subsidised fisheries and the anticipated reforms of the CFP, this study aims at estimating the impact of eliminating cost-reducing and capacity-enhancing fisheries subsidies on the Azorean economy. In particular, this study sets out to measure the impact of such a shock on various macro and micro variables pertaining to the regional economy using a dynamic CGE model based on a SAM for the Azores.

Mário Fortuna
Universidade dos Açores
Departamento de Economia e Gestão
Rua da Mãe de Deus, 58
9501-801 Ponta Delgada

Natacha Carvalho
Universidade dos Açores
Departamento de Oceanografia e Pescas
Cais de Santa Cruz
9901-862 Horta

Sameer Rege
Universidade dos Açores
Departamento de Economia e Gestão
Rua da Mãe de Deus, 58
9501-801 Ponta Delgada

Estimating the Impacts of Eliminating Fisheries Subsidies on the Small Island Economy of the Azores

Mário Fortuna (fortuna@uac.pt)
Natacha Carvalho (natacha@uac.pt)
Sameer Rege (sameer@uac.pt

Summary

Subsidies that reduce the costs incurred by fishers and increase profits for the industry can insulate fishers from economic signals, countering the economic incentive to stop fishing when it is unprofitable. Subsidies can thus be a major impediment to achieving economically productive fisheries, exacerbating overexploitation and delaying the necessary industry adjustments, particularly in the absence of effective management systems. Although some fisheries are profitable without government support, several studies have shown that many European fishing fleets are either running losses or returning low profits. In most cases operating costs are higher than gross revenue, resulting in a negative net contribution of fisheries to the economy, the deficit of which is largely funded by subsidies. Thus the cost of fishing to the public budget exceeds the total value of the catches. Recently, fishery subsidies have received much attention with a mounting literature on the urgent need to reduce capacity-enhancing subsidies and begin focusing on developing a profitable and sustainable industry that can adapt to changing economic and environmental conditions. Simple economic models showing how subsidies affect profits and therefore provide incentives for increased fishing effort have accompanied a number of overviews of subsidies published by leading intergovernmental and research institutions. A number of case studies have also illustrated the critical link between fleet capacity and subsidies and that some categories of subsidies are more distorting than others. However, most of the studies have been limited to estimating the value of these subsidies, and usually at the multinational or global level. None so far, to our knowledge, has estimated the economy-wide impact of reducing or eliminating fishing subsidies even though there is a growing consensus that subsidies should gradually be terminated. Moreover, the Fisheries Secretariat believes that capacity enhancing and fuel subsidies should be stopped immediately. Nonetheless, the new financial instrument of the CFP, the European Fisheries Fund (EFF 2007-2013), although an improvement on its previous homologous (FIFG 2000-2006), contains some ambiguous elements, which could open up for further increase of fishing capacity. A long-term approach is needed that encompasses more fundamental changes than using for example more efficient engines that initially reduce fuel consumption but in the long-run worsen the situation by contributing to increasing fishing effort on already overexploited stocks. On account of the global fisheries crises, highly subsidised fisheries and the anticipated reforms of the CFP, this study aims at estimating the impact of eliminating cost-reducing and capacity-enhancing fisheries subsidies on the Azorean economy. In particular, this study sets out to measure the impact of such a shock on various macro and micro variables pertaining to the regional economy using a dynamic CGE model based on a SAM for the Azores.

Introduction

A major problem affecting world fisheries today is overcapacity of which overfishing is both a cause and a consequence. Subsidies are now widely perceived as an underlying cause of overcapacity, the negative environmental, social and economic effects of which can be masked by increasing support from the government (Clark et al. 2005, Safina et al. 2005, Beddington et al. 2007). There is general consensus that fisheries subsidies cause great harm to the resource by exacerbating the problems resulting from the common resource issues of wild capture fisheries. But even if the common pool aspects are eliminated in the organization of a fishery, subsidies still lead to overexploitation of the resource through a new set of perverse incentives (Sakai et al 2008). Subsidies that reduce the costs of fishing and increase profits for the industry can insulate fishers from economic signals, countering the economic incentive to stop fishing when it is unprofitable. Subsidies can thus be a major impediment to achieving economically productive fisheries (Tupper 2002), exacerbating overexploitation and delaying the necessary industry adjustments, particularly in the absence of effective management systems. It is thus ironic that the dual crisis of overfishing and overcapacity is usually generated by the management system itself (Beddington et al. 2007).

The global fishing fleet is an estimated 250 per cent larger than needed to fish at sustainable levels (Porter 1998) and according to FAO, around 80 percent of the world's fisheries are now either overexploited, fully exploited, significantly depleted or recovering from overexploitation (FAO 2009). Myers and Worm (2003), argue that 90 per cent of all the "big fish" – large-bodied sharks, tuna, marlin and swordfish – have disappeared as a result of industrialized fishing and fishing down the food web. Furthermore, a recent study by leading fishery biologists and ecologist concluded that if current trends continue the state of the world's fisheries resources could be beyond repair by 2048. By removing the economic incentive to increase overcapacity, the problem of overfishing is curtailed and many authors today (e.g. Sakai 2000, Porter 2001, Clark et al. 2005, Sumaila et al. 2008) agree that eliminating capacity-enhancing fisheries subsidies may be the largest single action that can be taken to address global overfishing.

Global fisheries subsidies are currently estimated at €24 to €28 billion annually, of which capacity-enhancing and cost-reducing subsidies amount to at least €16 billion of the global total, an amount equivalent to approximately 25 per cent of the value of the world catch (Sumaila and Pauly 2006, Sumaila et al. 2009). Fisheries subsidies are not only a major driver of overfishing but also promote other destructive fishing practices, such as high sea bottom trawling, which would not be profitable without its large subsidies on fuel, and have been repeatedly linked to illegal, unreported, and unregulated (IUU) fishing, which is a major loss of revenue and impediment to achieving sustainable fisheries. A study by World Bank and FAO (Kelleher et al. 2008) estimated the cumulative global loss of potential economic benefits from fisheries at €1.6 trillion over the last three decades, as a result of the overexploitation of stocks and consequent loss in productivity.

Subsides, financial support, economic assistance or government financial transfers are just a few of the most commonly used names for payments that governments provide to the fisheries sector. Fisheries

subsidies, either direct (e.g. vessel buyback schemes) or indirect (e.g. forgone tax revenue on fuel), are payments made by governments or public bodies to the fishing sector that lowers the cost of a good or service, resulting in a private benefit. From the recipient's point of view, a subsidy is a transfer of funds that improves its position relative to domestic and international competitors. From the taxpayer's point of view, it is another form of government expenditure and ultimately means higher taxes. In other words, many citizens end up paying almost twice for their fish: once when purchasing and again through their taxes (Porter 2001).

When considering the wider economy, subsidies inject productive resources (such as capital and labour) into subsidised sectors at the expense of sectors that receive fewer or no subsidies, and that can therefore no longer afford to pay for them. This re-allocation of resources is important to both the effectiveness and the economy-wide costs of subsidies. The central role of markets is to allocate productive resources in a way that maximises their productivity, but by providing subsidies governments can override market signals by artificially boosting the profitability of selected economic activities. Although some fisheries are profitable without government support, several studies have shown that many European fishing fleets are either running losses or returning low profits (Pascoe et al. 1996, FAO 2001, FAO 2005, Poppe et al. 2006). In most cases operating costs are higher than gross revenue, resulting in a negative net contribution of fisheries to the economy. In other words, the cost of fishing to the public budget exceeds the total value of the catches, the deficit of which is largely funded by subsidies.

The widespread need to reform fisheries subsidies has been a matter of concern over the past years and has now been taken up as a high priority in such international fora as the FAO, WTO, OECD and UNEP. The fact that subsidies may increase fishing effort and thus have negative impacts on the level of fish stocks has been widely accepted in the fisheries literature (Hatcher and Robinson 1998, Porter 2001, Sumaila et al. 2006, Kelleher et al. 2008, Sumaila et al. 2008, Sharp and Sumaila 2009). Simple economic models showing how subsidies affect profits and therefore provide incentives for increased fishing effort have accompanied a number of overviews of subsidies published by leading intergovernmental and research institutions (Anderson 1986, Stone 1997, Arnason 1998, Milazzo 1998, Munro 1998; Nordstrom and Vaughan 1999, FAO 2000, WTO CTE 2000, Steenblik and Wallis 2001, Cox 2002, IEEP 2002, Munro and Sumaila 2002, OECD 2003, Sumaila et al. 2007). A number of case studies have also illustrated the critical link between fleet capacity and subsidies and that some categories of subsidies are more distorting than others (Holland et al. 1999, Pieters 2002, Porter 2004, Lindebo 2005). However, most of the studies have been limited to estimating the value of these subsidies, and usually at the multinational or global level (Sumaila et al. 2008). Only one study estimating the effects of subsidy removal was found in the literature. In this study, Jiniji (2010), estimated how income and price support subsidies in fisheries affect the incentives of people in the fisheries sectors and concluded that the effects of reducing existing subsidies on fisheries output would differ depending on the conditions of the economy. To our knowledge, none so far has estimated the economy-wide impact of reducing or eliminating fisheries subsidies even though there is a growing consensus that they should be (gradually) terminated.

The environmental and economic consequences of a fisheries subsidy depends essentially on the specific type of subsidy in question, as well as the regulatory, biological and commercial context in which it is applied (see UNEP for a review of the impact of various fisheries subsidies types under the different circumstances in which they may be provided). In many cases, government funds have been used to buy out excess fishing capacity and for various reasons such programs have been less effective than expected. First, often only the least efficient vessels are bought up, leaving total fishing capacity largely intact. Second, the buyback program by itself does not remove the economic incentives underlying overcapacity, which tends to increase once the buybacks are completed (Weninger and McConnell 2000, Clark et al. 2005, Clark 2007). Munro and Sumaila (2002) and Clark et al. (2005) investigated the possible negative effects of subsidies for vessel decommissioning schemes, with both papers demonstrating that buyback subsidies generally have a negative impact on resource conservation if they are anticipated by fishermen. Vessel construction subsidies are particularly damaging in terms of increasing capacity and only in 2007 did the European Union removed this type of support to the fishing industry. However, vessel modernisation schemes have their supporters since they include provisions for the purchase of more environmentally-friendly equipment or more efficient engines to help combat climate change. They nonetheless help reduce operating costs. The economic advantages of modernisation and upgrading of vessels should be sufficient incentive to stimulate private rather than public investment in a profitable industry (Parkes et al. 2009).

In addition to direct aid from the European Fisheries Fund and similar national aid schemes, the fishing industry also benefits from a number of indirect subsidies, the most important of which is the exemption from fuel taxes. Fuel price support, is another type of subsidy that reduces the costs of fishing activity, particularly since fuel constitutes a significant component of fishing costs, up to 60 per cent in some fisheries (Sumaila et al. 2008). Unlike other industries, many fisheries also benefits from free access to the natural resource it exploits and do not have to contribute to the public management costs associated with its activities.

In the current economic situation, government spending is to be scaled back whenever possible and it is not hard to envisage the budgetary advantages of rolling back on government assistance to fisheries. The efficiency gains of cutting back on fisheries subsidies could, however lead to a substantial increase in fish prices, a reduction in output and increased unemployment in fishing communities, which in turn could lead to social and political problems. The degree to which changes would occur is quite vague but points to the need for a quantitative simulation model capable of registering the effects of such supply shock on a number of economic sectors simultaneously.

In view of this and on account of the global fisheries crises, highly subsidised fisheries and the anticipated reforms of the CFP, the aim of this study was to quantitatively analyse the impact of reducing fisheries subsidies in the Azores. In particular, this study set out to measure the potential impact of such a shock on various macro and micro variables pertaining to the regional economy using a dynamic CGE model based on a SAM for the Azores.

Methodology

Study Area

The Azores, an outermost region of the European Union and designated as an Objective 1 region, has traditionally received large amounts of public subsidies partly due to its economic situation, largely brought on by its geographic features. As a small, remote island region, the Azores faces even greater development challenges than larger regions, with economic development constraints that include a small population size with limited trained and skilled personnel, a restricted and undiversified natural resource base, and a lack of infrastructures necessary to develop economic activity.

The fishing industry, due to its social and economic importance in coastal areas, has long been one of the most heavily subsidised production sectors. According to the available estimates, total subsidies on production amounted to €72million (€52 million of structural funds – ERDF, ESF, EAGGF and FIFG) for the Azores. Of the 45 sectors in the SAM, 43 were subsidised in one form or another in 2005, of these seven sectors received a positive net subsidy on production (defined as the difference between subsidies and output taxes). The fish-harvesting sector received the fourth highest value of subsidies amounting to €6.6 million, but with the second largest subsidy rate at almost 10 per cent. Subsidy rate is defined as the ratio of the net subsidy over the value of domestic output in the sector, thus, for every unit of domestic output in the primary fishing sector, 10 per cent is subsidised. On the other hand, the fish-processing sector was not subsidised in net terms, i.e. the taxes paid by the sector were greater than the amount of subsidies it received (Table 1).

Table 1. Economic Sectors with Net Subsidy Rates in 2005.

		Subsidies (€)	Taxes (€)	Net Subsidies (Subsidies – Taxes)	Subsidy Rate
Water transport	secE30	25,185,481	404,754	24,780,727	69.02
Fishing	secE2	6,608,938	1,298,656	5,310,283	**9.62**
Mining and quarrying	secE3	1,059,872	282,527	777,345	5.10
Agriculture, hunting and forestry, logging	secE1	19,873,015	6,627,499	13,245,516	4.41
Pulp, paper products; publishing and printing	secE12	367,209	257,691	109,519	0.99
Manufacture of dairy products	secE6	2,300,800	714,117	1,586,684	0.75
Fruits, vegetables, animal oils, grain mill, starches	secE9	1,065,133	894,524	170,609	0.30

The CGE Model of the Azores Economy - AzorMod

A previous SAM-based multiplier study (Carvalho in prep) analysing the nature of linkages and the impact of the fishing sector on the regional economy of the Azores, indicated that although the sector is relatively modest in economic terms, it has potential for generating value added and has some strong intersectoral interdependencies, in particular with the fish processing industry. However, SAM-based multipliers, although a useful tool in policy analysis for their ability to reveal in a simple and detailed manner key

aspects of the inter-relationships between sectors in an economy, have limitations inherent to the assumptions that characterise all Leontief models. In particular, these models ignore the substitution possibilities that might arise from a change in relative prices, and assume constant returns to scale in production i.e., an infinite elasticity of supply for all sectors. These problems can be overcome by using a SAM to calibrate a CGE model which, while requiring additional equilibrium assumptions, incorporates price-responsive behaviour and more flexible functional forms (Dixon et al. 1982; Kilkenny and Robinson 1990).

In a CGE model, endogenously determined relative prices trigger substitution effects in production and consumption. A CGE model allows calculation of the change in economic welfare resulting from a policy change, by comparing the value of real consumption in the counterfactual scenario against the baseline level. CGE models are also more appropriate in cases where management actions have significant indirect effects on prices or where productive inputs are limited in supply. The quality of the model results will be affected by the extent to which the model assumptions embody the actual regional economic constraints. Developing a CGE model has a higher computational cost than an IO model; the additional effort arises from the need to specify economic agents' behaviour (i.e. production technology, consumer preferences, and export and import behaviour), estimating the associated parameters, and then fully calibrating these relationships. Although some of these relationships have been estimated for other resource-dependent sectors, such as agriculture, they have not generally been well specified for fishery-related sectors.

The modelling platform for the Azores economy, referred to as AzorMod, is represented by a dynamic multi-sectoral computable general equilibrium model (CGE), based on the social accounting matrix (SAM) for the year 2005 (Fortuna and Rege 2010). The model was built and solved using the general algebraic modelling system (GAMS) (Rosenthal 2006), and incorporates the economic behaviour of six economic agents: firms, households, regional government, central government (mainland), European Commission and the external sector.

In this study, the AzorMod model was used to depict the effects of fisheries subsidy removal on the various agents in the Azores economy. A detailed technical account of the model can be found in Bayar et al. (2010), from which the brief description of the model and behaviour of each economic agent provided below borrows extensively.

Firms

The model distinguished between 45 perfectly competitive productive sectors consisting of both public and private firms. There are 45 types of commodities with each sector producing one or more types of them. Being rational, producers are assumed to maximise profits and consumers are assumed to maximise utility. Producers operate in perfectly competitive markets and production prices equal average and marginal costs, a condition implied by profit maximisation for a constant return to scale.

The level of production (output) for each economic activity is determined from a nested production structure: in the first stage, producers are assumed to choose between intermediate inputs and value-

added according to a Leontief production function, and in the second stage, the optimal level of labour and capital is chosen according to a constant elasticity of substitution (CES) function.

Domestic production is valued at basic prices net of taxes but includes subsidies on production from the regional government and direct subsidies on production from the European financial Instrument for Fisheries Guidance (FIFG), European Agriculture Guidance and Guarantee Fund (EAGGF), European Regional Development Fund (ERDF), European Social Fund (ESF) and from US.

Domestic production is given by the sum of value added for branch of activity at basic prices and intermediate commodities by sector valued at the price of the commodities less subsidies on intermediate consumption but including trade and transport margins and value-added taxes on intermediate consumption. Treated at an aggregate level, firms' savings are given by the net operating surplus less transfers by firms to households and the foreign sector.

Households

Six households are distinguished on income levels and each household income group receives a share of capital income, labour income, unemployment benefits from the central government and other net transfers from the regional and central governments. Households pay income tax to the government and save a fixed fraction of net income. Their propensity to save is endogenous and reacts to changes in the after-tax average return to capital. The disposable budget for consumption is allocated between different goods and services according to a Stone-Geary utility function in the context of a linear expenditure system (LES), which represents a set of consumer demand equations linear to total expenditure (Geary 1950, Stone 1954). Household welfare gains/loses are valued using the equivalent variation in income, which is based on the concept of a money metric indirect utility function (Varian 1992). Equivalent variation measures the income needed to make households as well off as in the new counter-factual equilibrium (policy scenario) evaluated at benchmark prices. Thus, equivalent variation is positive for welfare gains from policy scenario and negative for losses.

Regional Government

Total government revenues consist of all taxes, such as taxes on income and wealth, taxes on products and production, EU funds and transfers from the foreign sector. The EU funds are transferred to the regional government budget, which allocates them between different sectors. Total government expenditures comprise the public current consumption, subsidies on products and on production, and total transfers by the government. The difference between the regional government revenues and expenditures yields the government savings.

Central (mainland) Government

The central government collects all social security contributions, provides unemployment benefits and makes transfers to households and the regional government.

European Commission

The European commission provides direct subsidies (EU funds) to the production sectors and other EU funds to the regional government.

Foreign Trade

The specification of foreign trade is based on the small- open economy assumption, i.e. the region is a price taker (has no influence on world market prices) in both its imports and exports markets. The model distinguished four main groups of trade partners: mainland, EU, US and the rest of the world (RoW). The Armington (1969) assumption of imperfect substitution possibilities between domestically produced and imported goods is adopted in the model. Thus, domestic consumers use composite goods of imported and domestically produced goods according to a CES function. Similarly, limited substitution possibilities are also assumed to exist between goods produced for the domestic market and exports, captured by a constant elasticity of transformation (CET) function.

Price Equations

A common assumption for CGE models is that the economy is initially in equilibrium with the quantities normalised in such a way that prices of commodities equal unity. Due to the homogeneity of degree zero in prices, the model only determines relative prices. In the AzorMod, the GDP inflator is used as the *numéraire* price level against which all relative prices in the model are measured.

Policy Simulations

Simulating the region's post-subsidy economy involves removing fisheries subsidies from the model of the benchmark year (2005). Scenario-specific changes are fed into the model and the simulation results are compared to the benchmark case or reference scenario to observe changes brought by such policies. Thus, results are interpreted as an impact relative to the base situation, which would imply no action by the government, or business as usual (BAU).

The following scenarios were considered: (SCN1) a total elimination of all subsidies to the fish harvesting sector (FIFG, ERDF; ESF, and subsidies on production); (SCN2) a 12 per cent annual reduction of all subsidies in the primary fishing industry, and (SCN3) elimination of subsidies to the fish manufacturing sector. In addition, a contrasting scenario (SCN4) simulating a 50 per cent increase in all subsidies to the fishing sector was considered.

The results are largely driven by the closure used in the model and given that the nature of the archipelago's economy is extremely sensitive to external support from the mainland, the closure adopted was that investments adapt to the savings and thus is a binding constraint. To prevent free lunch from the RoW and the government, the foreign transfers are fixed in real terms along with the transfers to households from the regional government.

Simulation Results and Discussion

The model was calibrated using a SAM constructed for the Azorean economy based on 2005 data, incorporating the 45 sectors and a time horizon of 12 years (2005 to 2016). For the simulations, attention was focused on the main macro and micro economic effects. Welfare impacts were not considered in

depth due to the lack of detailed data on fishing households in the model. Equivalent variation was used to analyse the overall effects of the various policy actions on welfare.

The results of the simulations showing the impact on various macroeconomic variables for the different subsidy-policy scenarios are listed in Table 2. According to the findings, subsidy reduction or elimination policies have an overall positive effect on the economy as a whole, with the exception of exports and employment. In most cases, as the size of subsidy reduction on fisheries increases there is a greater positive/negative effect. In the policy scenario simulating a 12 per cent annual subsidy reduction, GDP increases by 0.01 per cent with respect to the BAU in the first year (corresponding to €0.2m) increasing to 0.18 per cent in 2016 (corresponding to € 6.2m). When subsidies are eliminated altogether, GDP increases by 0.12 per cent from the BAU (€3.2m) in 2005 and by 0.25 in 2016 (€8.5m). Conversely, in the counterfactual scenario of enhancing subsidies by 50 per cent, GDP decreases by 0.05 per cent in the first year (corresponding to €1.4m) and continues to decrease throughout the time horizon (with a decrease of €3.8m in 2016).

Nevertheless, in the majority of the cases the effects are in the order of one-tenth of a percent or less, indicating that the effects of lifting or enhancing fisheries subsidies are not substantial on the economy as a whole. Eliminating subsidies would have a greater effect on employment, increasing the regional unemployment rate by almost 2.5 per cent in the first year, although with a decreasing effect over the time horizon.

Table 2. Macroeconomic effects in real terms as % change to the BAU (SCN1 – 100 per cent subsidy removal to the primary fishing industry; SCN2 – 12 per cent annual subsidy reduction to the primary fishing sector; SCN3 – 100 per cent subsidy removal to the fish manufacturing sector; SCN4 – and 50 per cent increase of subsidies to the primary fishing sector).

	Scenario	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
GDP	SCN1	0.12	0.13	0.14	0.15	0.16	0.18	0.19	0.20	0.21	0.22	0.23	0.25
	SCN2	0.01	0.02	0.03	0.04	0.06	0.07	0.09	0.10	0.12	0.14	0.16	0.18
	SCN3	0.05	0.05	0.05	0.06	0.06	0.07	0.07	0.08	0.08	0.09	0.09	0.10
	SCN4	-0.05	-0.06	-0.06	-0.07	-0.07	-0.08	-0.08	-0.09	-0.09	-0.10	-0.10	-0.11
Intermediate consumption	SCN1	0.14	0.16	0.18	0.19	0.21	0.23	0.25	0.26	0.28	0.30	0.32	0.34
	SCN2	0.01	0.02	0.04	0.05	0.07	0.09	0.11	0.13	0.15	0.18	0.21	0.24
	SCN3	-0.01	0.00	0.00	0.01	0.01	0.02	0.03	0.03	0.04	0.04	0.05	0.06
	SCN4	-0.06	-0.07	-0.08	-0.08	-0.09	-0.10	-0.11	-0.12	-0.12	-0.13	-0.14	-0.15
Private Consumption	SCN1	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.15	0.16	0.17	0.18	0.19
	SCN2	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.10	0.11	0.13
	SCN3	0.01	0.02	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.06	0.06
	SCN4	-0.03	-0.04	-0.04	-0.05	-0.05	-0.05	-0.06	-0.06	-0.07	-0.07	-0.08	-0.09
Government Consumption	SCN1	0.20	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.18	0.18	0.18	0.18
	SCN2	0.01	0.03	0.04	0.06	0.08	0.09	0.11	0.12	0.14	0.16	0.17	0.19
	SCN3	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.17	0.17	0.17
	SCN4	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08
Gross fixed Investment	SCN1	0.55	0.59	0.64	0.69	0.73	0.78	0.83	0.87	0.92	0.97	1.02	1.06
	SCN2	0.04	0.09	0.14	0.19	0.25	0.31	0.38	0.46	0.53	0.62	0.70	0.80
	SCN3	0.18	0.20	0.22	0.24	0.25	0.27	0.29	0.31	0.33	0.35	0.37	0.40
	SCN4	-0.23	-0.25	-0.27	-0.30	-0.32	-0.34	-0.36	-0.38	-0.40	-0.42	-0.44	-0.46
Exports	SCN1	-0.11	-0.11	-0.11	-0.11	-0.11	-0.11	-0.10	-0.10	-0.09	-0.08	-0.08	-0.07
	SCN2	-0.01	-0.02	-0.03	-0.03	-0.04	-0.05	-0.06	-0.07	-0.08	-0.09	-0.09	-0.10
	SCN3	-0.11	-0.12	-0.12	-0.12	-0.12	-0.12	-0.12	-0.12	-0.12	-0.12	-0.12	-0.12
	SCN4	0.04	0.04	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.03
Imports	SCN1	0.24	0.26	0.28	0.30	0.32	0.34	0.36	0.38	0.40	0.42	0.44	0.46
	SCN2	0.02	0.04	0.06	0.08	0.11	0.14	0.17	0.20	0.23	0.27	0.31	0.35

	SCN3	0.08	0.08	0.09	0.10	0.11	0.12	0.12	0.13	0.14	0.15	0.16	0.17
	SCN4	-0.10	-0.11	-0.12	-0.13	-0.14	-0.15	-0.16	-0.17	-0.17	-0.18	-0.19	-0.20
Private GDP	SCN1	0.09	0.10	0.12	0.13	0.15	0.17	0.19	0.21	0.22	0.24	0.26	0.29
	SCN2	0.01	0.01	0.02	0.03	0.05	0.06	0.08	0.09	0.11	0.13	0.15	0.18
	SCN3	-0.01	-0.01	0.00	0.00	0.01	0.02	0.02	0.03	0.04	0.05	0.05	0.06
	SCN4	-0.04	-0.05	-0.05	-0.06	-0.07	-0.07	-0.08	-0.09	-0.10	-0.11	-0.12	-0.13
Foreign balance	SCN1	0.46	0.49	0.52	0.55	0.58	0.61	0.64	0.67	0.70	0.73	0.76	0.79
	SCN2	0.03	0.07	0.11	0.16	0.20	0.25	0.31	0.36	0.42	0.49	0.55	0.62
	SCN3	0.19	0.21	0.22	0.23	0.25	0.26	0.27	0.29	0.30	0.32	0.33	0.34
	SCN4	-0.19	-0.21	-0.22	-0.24	-0.25	-0.26	-0.28	-0.29	-0.30	-0.32	-0.33	-0.34
National Employment	SCN1	-0.10	-0.09	-0.09	-0.09	-0.09	-0.08	-0.08	-0.08	-0.08	-0.08	-0.07	0.00
	SCN2	0.00	0.00	0.00	-0.09	-0.09	-0.08	-0.08	-0.08	-0.08	-0.08	-0.07	-0.07
	SCN3	0.00	0.00	0.00	-0.09	0.00	0.00	0.00	0.00	-0.08	0.00	0.00	0.00
	SCN4	0.10	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
Unemployment Rate (%)	SCN1	2.48	2.38	2.26	2.14	2.02	1.90	1.78	1.65	1.52	1.39	1.25	1.11
	SCN2	0.19	0.37	0.54	0.71	0.87	1.04	1.19	1.33	1.48	1.61	1.73	1.85
	SCN3	0.51	0.48	0.45	0.41	0.37	0.32	0.27	0.22	0.17	0.12	0.06	0.00
	SCN4	-1.03	-0.99	-0.94	-0.90	-0.85	-0.80	-0.75	-0.70	-0.64	-0.59	-0.53	-0.47

Tables A1 to A4, in the annex, show the effects of the different subsidy-policy scenarios on the various consuming and producing sectors simulated for two points in time: 2010 and 2015. According to the findings, and as expected, the sector that looses the most with subsidy reduction policies is fishing, both the primary and the processing industries, the latter due to its linkage effects with the former. As the percentage of subsidy reduction increases, both sectors experience greater reduction in consumption, exports and domestic sales, which also tend to increase over time. Conversely, both the primary and fish processing sectors benefit from enhanced subsidies. On the other hand, the simulation results indicate that the effects of lifting fisheries subsidies on most other sectors in the economy are not substantial. In fact, in most cases the effects are positive and when negatively affected, these effects are generally less than one per cent.

Due to the nature and use of the subsidies in question, reduction policies would certainly increase the costs of production in the fishing sector and negatively affect output if fishers do not try to partially offset income reduction with increased fishing effort. Reductions in output, due to higher operation costs, would increase the cost of fish products and consequently, reduce consumption. Since consumers are assumed to maximise utility, they may either substitute high-priced domestically produced goods with cheaper imported products or increase their consumption of other food items, such as agriculture, meat and manufactured goods. The price response to a greater demand for other food items may not be so great as the impact of increased fish prices, enabling people to consume basic commodities without significantly affecting household expenditure. The reverse occurs with a subsidy increase as fish becomes cheap, the consumption of domestic products increase (no need to substitute with imported goods), resulting in less consumption of other food items. However, the share of household expenditure on fish products is less than that of agriculture, meat and dairy, and other manufactured items such as beverages, and hence the impact will chiefly affect these other producing sectors. In a previous analysis (Carvalho, in prep), the share of fish products, both fresh and processed was found to be small when compared to other food item, roughly around one per cent each, whereas the share of agriculture amounted to around 4 per cent

and manufactured goods significantly greater. The impacts on agriculture, meat and dairy, and other manufactured food items will affect the rest of the economy due to their greater linkage effects with other economic sectors.

As with the response of the demand categories to subsidy removal, in most cases, the percentage changes in production categories increases as the subsidy removal rates increases, and are quite substantial for value added and employment in the fishing sector. On the other hand, subsidy reduction and elimination policies have an overall positive, although relatively small, effect on all other economic activities in the region. Therefore, fisheries subsidy removal does not seem to have a significant effect on the overall economy in terms of production. Conversely, subsidy enhancement policies benefit the fishing sector but have a general negative effect on the economy as a whole.

When considering the elimination of subsidies to the fish-processing sector only (SCN3), imports of fish products decrease substantially. The reason for this may be that the use of imported raw materials (tuna) for the fish-processing industry is highly subsidised, more so than the use of domestic primary products. Being rational and profit maximisers, producers will substitute domestic goods with imported raw materials if these are cheaper, lowering the cost of production. Without subsidies, the price of these imported goods will increase, and hence a decrease in demand (reduction in imports). The costs of production will increase – even if domestic goods are now cheaper than imported raw materials, the domestic supply is not enough to satisfy the demand[1], and raw material would have to be imported nonetheless – reducing output and hence exports.

[1] The tuna canning industry requires a supply of around 30 thousand tonnes of raw materials annually, while domestic production of tuna species for the industry is generally less than 7 thousand tonnes, with large interannual variations (Miguel Machete, pers.com).

Subsidy-policies on Welfare

This study used the concept of equivalent variation (EV) to analyse the impact of the different subsidy-policies on households' welfare. EV compares the level of households' consumption at the given price and income in the base scenario to the levels of consumption in the counterfactual scenarios. In principle, equivalent variation can be interpreted as the minimum amount of money that has to be given to the households to renounce a utility increasing project or the maximum amount of money that households are willing to pay to prevent a utility decreasing change. As used in this study, EV is defined as the income required to be taken away from a household to make it equivalently worse off or better off following a price change. Thus, a positive EV implies welfare improvement, while a negative EV implies welfare deterioration (loss).

Table 3 presents the simulation results obtained on welfare (EV) and shows that there is a positive impact for all household groups for the entire period when considering reduction policies. Increasing subsidies has a negative effect on all household groups throughout the time horizon. In this case where the equivalent variation is negative, the household needs to be given money at the original price to have the same effect on their welfare. In general, the lower income household groups benefit the most from the elimination/reduction policies but bear a slightly greater share of the burden with increasing subsidies.

Table 3. Simulation results on equivalent variation on household income (SCN1 – 100 per cent subsidy removal to the primary fishing industry; SCN2 – 12 per cent annual subsidy reduction to the primary fishing sector; SCN3 – 100 per cent subsidy removal to the fish manufacturing sector; SCN4 – and 50 per cent increase of subsidies to the primary fishing sector).

	Q1				Q2				Q3				Q4				Q5				Q6			
	SCN1	SCN2	SCN3	SCN4	SCN1	SCN2	SCN3	SCN4	SCN1	SCN2	SCN3	SCN4	SCN1	SCN2	SCN3	SCN4	SCN1	SCN2	SCN3	SCN4	SCN1	SCN2	SCN3	SCN4
2006	0.13	0.01	0.01	-0.06	0.10	0.01	0.01	-0.05	0.10	0.01	0.01	-0.04	0.07	0.01	0.01	-0.03	0.06	0.01	0.01	-0.03	0.03	0.00	0.01	-0.02
2007	0.14	0.02	0.01	-0.06	0.11	0.02	0.02	-0.05	0.10	0.02	0.01	-0.05	0.07	0.01	0.01	-0.03	0.07	0.01	0.01	-0.03	0.04	0.01	0.01	-0.02
2008	0.14	0.03	0.02	-0.06	0.12	0.03	0.02	-0.05	0.11	0.02	0.02	-0.05	0.08	0.02	0.02	-0.04	0.08	0.02	0.02	-0.04	0.05	0.01	0.01	-0.02
2009	0.15	0.04	0.02	-0.06	0.12	0.04	0.02	-0.05	0.12	0.03	0.02	-0.05	0.09	0.02	0.02	-0.04	0.09	0.02	0.02	-0.04	0.06	0.01	0.02	-0.03
2010	0.15	0.06	0.02	-0.07	0.13	0.05	0.03	-0.06	0.12	0.04	0.02	-0.06	0.10	0.03	0.02	-0.04	0.10	0.03	0.02	-0.04	0.07	0.02	0.02	-0.03
2011	0.16	0.07	0.02	-0.07	0.14	0.06	0.03	-0.06	0.13	0.05	0.03	-0.06	0.11	0.04	0.03	-0.05	0.11	0.04	0.03	-0.05	0.07	0.03	0.02	-0.03
2012	0.16	0.08	0.03	-0.07	0.15	0.07	0.03	-0.07	0.14	0.07	0.03	-0.06	0.12	0.05	0.03	-0.05	0.11	0.05	0.03	-0.05	0.08	0.03	0.03	-0.04
2013	0.17	0.10	0.03	-0.07	0.16	0.08	0.04	-0.07	0.15	0.08	0.04	-0.07	0.13	0.06	0.04	-0.06	0.12	0.06	0.04	-0.05	0.09	0.04	0.03	-0.04
2014	0.18	0.11	0.03	-0.08	0.16	0.10	0.04	-0.07	0.16	0.09	0.04	-0.07	0.14	0.07	0.04	-0.06	0.13	0.07	0.04	-0.06	0.10	0.05	0.03	-0.04
2015	0.18	0.13	0.03	-0.08	0.17	0.11	0.04	-0.08	0.17	0.11	0.04	-0.07	0.15	0.09	0.05	-0.07	0.14	0.08	0.04	-0.06	0.11	0.06	0.04	-0.05
2016	0.19	0.14	0.04	-0.08	0.18	0.13	0.05	-0.08	0.18	0.12	0.05	-0.08	0.16	0.10	0.05	-0.07	0.15	0.10	0.05	-0.07	0.12	0.07	0.04	-0.05
2017	0.20	0.16	0.04	-0.09	0.19	0.14	0.05	-0.09	0.19	0.14	0.05	-0.08	0.17	0.11	0.05	-0.08	0.16	0.11	0.05	-0.07	0.13	0.08	0.05	-0.06

EV arises from the expense on commodities, and as agriculture and manufactured food items have a greater share, any effect on these will affect their utility. Hence EV will move in the same direction as the subsidy-policy, i.e. elimination of subsidies to the fishing sector will increase the price of fish generating a greater consumption of other food items, raising EV, while the reverse occurs with increased subsidies. The extent of change is determined by the elasticities of substitution between domestically produced and imported commodities as given by the Armington assumption and the constant elasticity of transformation (CET) function. The Armington elasticities (elasticities of substitution in demand between

imported commodities and domestically produced commodities) are based on the differentiation of products with respect to their origin and the imperfect substitution between imports and domestic supply. The degree of similarity between the two sources of supply is captured by the Armington elasticity and, the higher the value of this parameter the closer the degree of substitution. A high value of this parameter means that imports and domestic supplies are considered by consumers to be virtually identical and conversely, a low value means that the two products are dissimilar, i.e. they are real substitutes. If the elasticities were low then there would not be a greater change in imports and exports, which is not the case, suggesting that consumers are very sensitive to price changes and that imports play an important role in providing the consumer a choice between cheaper imports and expensive domestic fish.

Final Remarks

Many economists (e.g. free market and *laissez-faire* economists) would argue against any use of subsidies in general, and most international organisations call for the termination of harmful or "perverse" subsidies (WTO 2000, OECD 2005, UNEP 2008, TEEB 2009). According to OECD (2005), subsidies are often inefficient, expensive, socially inequitable and environmentally harmful, imposing a burden on government budgets and taxpayers, which are all strong arguments for reforming the existing subsidy policies. Under the International Plan of Action for Managing Fishing Capacity, the Food and Agriculture Organisation of the United Nations (FAO) has called for the reduction and progressive elimination of subsidies and economic incentives that contribute directly or indirectly to the build-up of excessive capacity, prolonging a fisher's incentive to remain in a fishery even when it is being overfished (FAO, 2001). In addition, the link between the current fisheries crisis and EU subsidies is broadly accepted by governments, as reflected in commitments made at the 2002 World Summit on Sustainable Development in Johannesburg and discussions within the World Trade Organization Doha Round of negotiations.

This study analysed the social and economic impacts of fisheries subsidy policies beyond the primary harvesting sectors and into the larger economy. The extent of these impacts depends largely on the degree of economic linkage that the fishery sector has with the rest of the economy. The simulation results suggest that reduction, and in particular, elimination policies of fisheries subsidies would have a substantial effect, however, the negative social and economic effects would be largely confined to the fishing sector, and through its linkages, the fish-processing sector. Conversely, the augmentation of fishery subsidies would benefit the fishing sector with an overall adverse effect on the rest of the economy. Fishery policies therefore must take into consideration the socio-economic impacts across the region, not just within a fishing community.

The efficiency gains of cutting back on fisheries subsidies could lead to a reduction in output and substantial increase in fish prices. Subsidy cutbacks in the sector would also almost certainly imply employment losses in fishing communities, which in turn could lead to social and political problems. These

wage earners normally lack skills and education that can be used in other sectors of the economy. The opportunity costs of this labour force is generally low, thus management initiative will be needed to re-train fishery labourers for jobs outside the fisheries (Bhat and Bhatta 2006). Although the Azores region has experienced industrial growth in the past, even attracting migratory labourers from out-of-the region, in the current economic situation non-fishery employment opportunities may not be plentiful, particularly on the smaller islands. Thus, in the midst of an economic crisis with rising unemployment, subsidy reduction policy measures may be difficult to implement. Even in more healthy economic times, programmes to help ease the employment transition from fisheries to other sectors, such as manufacturing, construction, and service sectors, should be enforced. On the other hand, the budgetary advantages of cutting back much of this government assistance in the midst of an economic crisis is not hard to visualise and the money recovered from fisheries subsidies could be used to fund job creation and employment training programs, or even direct compensation programs. However, the fear of social repercussions within the fishing sector from removing subsidies has probably been one of the main reasons why management initiatives have not progressed. One consequence of the vicious circle of overfishing, overcapacity and low economic resilience is the high political pressure to increase short-term fishing opportunities at the expense of the future sustainability of the industry. In these cases the industry has counteracted the short-term negative economic effects by receiving heavy public financial support, one of the results being to artificially maintain excess fishing capacity.

Norway's experience shows that it is possible to drastically reduce subsidies without destroying the industry and its natural resources. Norway gradually reduced subsidies to the fishing sector between 1981 and 1994, and although the number of fishers declined, the fishing sector is now self-supporting and in many ways healthier than it was at the height of subsidies. The subsidy reform may have contributed to improved fish stocks, although this effect is difficult to isolate from other factors e.g. variability of stocks, improved management regime and the fact that Norway shares its stocks with its neighbours. Norway's success was due to several factors, and included: the existence of optional employment opportunities for fishers who 'lost out' in the immediate aftermath of the subsidy removals, as the reforms were undertaken during good economic times; the fall in oil prices in 1986 deprived the government of revenue and convinced many of the need for significant reform; there was external pressure in the form of various multilateral agreements and, the transition was gradual which helped fishers to take steps to prepare for the changes. Additionally, the government combined the transition with other social measures to lessen the impact on those who had come to depend on the subsidies (OECD 2006).

The conventional belief, however, that fisheries subsidies cause overfishing and hence a reduction in fisheries subsidies would contribute to mitigating overfishing and conserving fisheries resources may not stand true in all cases. According to Jinji (2010), the effects of reducing existing subsidies in the fisheries sector under some conditions may actually produce the opposite results, i.e. that a reduction in fisheries subsidies could accelerate overfishing and reduce fisheries resource stocks. For example, in a small open economy with no enforced catch quotas and no alternative employment opportunities for workers in the

fisheries sector, a reduction in subsidies may actually increase output since workers may try counteract reductions in income from cuts in subsidies by increasing labour, and thus, fishing effort. The key is how the change in subsidies will affect the incentives of workers who engage in fisheries, since if a reduction in subsidies causes workers to put more effort into fishing, it may yield unexpected and undesirable results in fisheries with inadequate management. Therefore, the effects of reducing fisheries subsidies should be carefully examined as well as strengthening fisheries resource management to ensure that subsidy reform mitigates overfishing and conserves fisheries resources (Jinji 2010).

New Zealand also undertook a major reform of its fisheries policy in the early 1990s. Subsidies were eliminated virtually overnight. However, subsidy reduction alone would not have been enough to create a sustainable fishing sector and would have caused substantial financial and social distress. It would also have had a negative impact on stocks due to overfishing resulting from fishermen increasing effort in order to try and cover marginal costs. For these reasons, the reduction was combined with a major change in the management regime, i.e. the introduction of rights-based management and individual transferable quotas, combined with a minimum buy-out of existing rights. These measures gave those remaining in the sector a good chance of creating a profitable business environment, while allowing those who wished to leave to be bought out (OECD 2007).

A subsidy reduction policy should also take into consideration inherent biological and economic variability between different vessel classes. A uniform effort reduction may not be necessary, for example, reducing subsidies in fisheries that are already or near overfished or fleets that are overcapitalised as opposed to smaller less capitalised fleets. According to Bhat and Bhatta (2006), a non-uniform reduction strategy may solve two types of externalities commonly observed in fisheries (Townsend 1990): the short-run externalities which result in higher costs of fishing due to vessel ‘crowding’, and the long-run externalities which occur due to stock collapse following excessive harvesting. For example, the partial removal of cost-inefficient vessels could help ease the crowding effects while limiting future expansion of vessels in overexploited fisheries may restore the stocks, particularly of demersal species. Stock improvements may ultimately boost the profit margins in the fish-harvesting sector. Further, these policies should be constantly revisited to account for stock improvements or periodic or unexpected changes in straddling stocks as prolonged effort reduction may result in unnecessary decline in production and unwarranted regional impacts (Bhat and Bhatta 2006).

CGE models are helpful powerful tools for policy analysis; however, the model used in this study measured the effects at the fishery level only. For a more effective analysis, the fishing sector should be augmented in the SAM in order to evaluate the effects of different policy scenarios on the various subsectors (e.g. fleet segments). Furthermore, the model does not take into account how the fishery system will react to such shocks, for example, increasing fishing effort, and subsequently, effects on the resource. For this a bio-socio-economic model is required, integrating biological/ecological and fisheries sub-models with the economic (SAM) model. This however, was out of the scope of the present study,

nonetheless, this exercise constitutes an important step towards taking an integrated approach to fisheries management in the Azores, by filling in the information gap on the economics of fisheries.

Bibliography

Anderson, L.G. (1986). *The Economics of Fisheries Management,* Revised and Enlarged Edition. The Johns Hopkins University Press, Baltimore, MD.

Armington, P.S. (1969). A Theory of Demand for Products Distinguished by Place of Production. *International Monetary Fund Staff Papers* 16: 159-176.

Arnason, R. (1998). Fisheries Subsidies, Overcapitalisation and Economic Losses. *In:* A. Hatcher and K. Robinson (eds). *Overcapacity, Overcapitalisation and Subsidies in European Fisheries*. Portsmouth, UK: CEMARE.

Bayar, A., M. Fortuna, C. Mohora, M. Opese, S. Sisik and S. Rege (2010). AzorMod: CGE Model of the Azorean Economy. *In:* M. Fortuna and S. Rega (eds) (2010). *Computable General Equilibrium Models: Theory and Applications*. Centro de Estudos de Economia Aplicada do Atlântico (CEEAplA), University of Azores, Ponta Delgada. 219pp

Beddington, J.R., D.J. Agnew and C.W. Clark (2007). Current problems in the management of marine fisheries. *Science*, vol. 316:1713-1716.

Bhat, M. G. and R. Bhatta (2006). Mechanization and Technical Interactions in Multi-species Indian Fisheries: Implications for Economic and Biological Sustainability. *Marine Policy*, 30: 237-248.

Carvalho, N. (in prep.). A SAM based multiplier analysis of the commercial fishing industry in the Azores.

Clark, C.W. (2007). *The worldwide crisis in fisheries: Economic models and human behaviour.* Cambridge Univ. Press, Cambridge, UK.

Clark, C., G. Munro, and U.R. Sumaila (2005). Subsidies, Buybacks and Sustainable Fisheries. Presented at the International Workshop on Fishing Vessel and License Buy-Back Programs. La Jolla, CA, USA, 22-24 March.

Cox, A. (2002). *OECD Work on Defining and Measuring Subsidies in Fisheries*, Background Paper prepared for the OECD Workshop on Environmentally Harmful Subsidies, Paris, 7-8 November.

FAO (2000), *Report on the Expert Consultation on Economic Incentives and Responsible Fisheries*, FAO Fisheries Report No. 638, Rome.

FAO (2001). *Managing Fishing Capacity: A Review of Policy and Technical Issues*. FAO Fisheries Technical Paper 409, Prepared by S. Cunningham and D. Greboval. Rome, Italy: FAO.

FAO (2009). State of World Fisheries and Aquaculture, 2008. FAO Fisheries and Aquaculture Department, Rome.

Fortuna, M. and S. Rega (Eds) (2010). *Computable General Equilibrium Models: Theory and Applications*. Centro de Estudos de Economia Aplicada do Atlântico (CEEAplA), University of Azores, Ponta Delgada. 219pp.

Geary R.C. (1950). A Note on "A Constant-Utility Index of the Cost of Living". *Review of Economic Studies*, vol. 18:65-66.

Hatcher, A., and K. Robinson (1998). Overcapacity, Overcapitalisation and Subsidies in European Fisheries. Proceedings of the First Workshop held in Portsmouth, UK, 28-30 October. Portsmouth, UK: CEMARE publication.

Holland, D., E. Gudmundsson, and J. Gates (1999). Do Fishing Vessel Buyback Programs Work: A Survey of the Evidence. *Marine Policy,* vol. 23(1):47–69.

IEEP (2002). Subsidies to the European Union Fisheries Sector. Paper Commissioned by WWF European Fisheries

Campaign, October, London, England.

Jinji, N (2010). Subsidies, Fisheries Management, and International Trade. RIETI Discussion Paper Series 10-E-023, Kyoto University, 21p.

Kelleher, K., R. Willmann and R. Arnason (2008). The Sunken Billions: The Economic Justification for Fisheries Reform. World Bank and FAO, 128pp.

Lindebo, E. (2005). Trends in Economic Capacity of the Danish Fishing Fleet, 1996–2002. *Acta Agricultur Scandinavica Section C. Food Economics*, vol. 1(4):207–21.

Milazzo, M. (1998), *Subsidies in World Fisheries: A Re-examination*, World Bank Technical Paper No. 406, Washington.

Parkes, G., S. Walmsley, T. Cambridge, R. Trumble, S. Clarke, D. Lamberts, D. Souter and C. White (2009). Review of Fish Sustainability Information Schemes. Final report. MRAG/DIFD, 180pp.

Munro, G. (1998). The Economics of Overcapitalisation and Fishery Resource Management: A Review. *In*: A. Hatcher and K. Robinson (eds). O*vercapacity, Overcapitalisation and Subsidies in European Fisheries*. Portsmouth, UK: CEMARE.

Munro, G.R. and U.R. Sumaila (2001), "Subsidies and their potential impact on the management of the ecosystems of the North Atlantic", in T. Pitcher, U.R. Sumaila and D. Pauly (eds), *Fisheries Impacts on North Atlantic Ecosystems: Evaluations and Policy Explorations*, University of British Columbia Fisheries Centre Research Report 9(5), Vancouver, pp. 10-27.

Myers, R. and B. Worm (2003). Rapid worldwide depletion of predatory fish communities. *Nature*, vol. 423:280-283.

OECD (1993). *Economic Assistance to the Fishing Industry: Observations and Findings*. Directorate for Food, Agriculture and Fisheries, Committee for Fisheries, Paris.

OECD (2000). *Transition to Responsible Fisheries: Economic and Policy Implications*, OECD Publishing, Paris, 276pp.

OECD (2001). *Review of Fisheries in OECD Countries: Policies and Summary Statistics*, OECD Publishing, Paris, 720pp.

OECD (2006). Financial support to fisheries: implications for sustainable development. OECD Publishing, Paris, 378pp.

OECD (2007). Subsidy Reform and Sustainable Development: Political economy aspects. OECD Publishing, Paris, 130pp.

Pascoe, S., C. Robinson and C. Coglan (1996). Economic and financial performance of the UK English Channel Fleet. CEMARE Research Report No. 44, CEMARE, University of Portsmouth, UK, 55p.

Pieters, J. (2002), *What Makes a Subsidy Environmentally Harmful: Developing a Checklist Based on the Conditionality of Subsidies*, paper presented to the OECD Workshop on Environmentally Harmful Subsidies, Paris, 7-8 November.

Poppe, K.J., H. van Oostenbrugge and K. Taal (2006). The Economic Performance of European Fishing Fleets. *EuroChoices vol* 5(3):26-27.

Porter, G. (1998). *Fisheries Subsidies, Overfishing and Trade*. UN Environment Programme (UNEP), Geneva, Switzerland.

Porter, G. (2001), *Fisheries Subsidies and Overfishing: Towards a Structured Discussion*, UN Environment Programme (UNEP), Geneva, Switzerland.

Porter, G. (2002), *Subsidies and the Environment: An Overview of the State of Knowledge*, Paper presented to the OECD Workshop on Environmentally Harmful Subsidies, Paris, 7-8 November.

Porter, G. (2004). *A Matrix Approach to analyzing the resource impacts of fisheries subsidies*. Draft Paper March 2004 UNEP Workshop on Fisheries Subsidies, Geneva April 2004. UNEP, Geneva.

Rosenthal, R. (2006). *GAMS - A User's Guide*. GAMS Development Corporation, Washington, 271pp.

Safina, C., A. A. Rosenberg, R.A. Myers, T.J. Quinn II and J.S. Collie (2005). Oceans: U.S. Ocean Fish Recovery: Staying the Course. *Science*, vol. 309, no. 5735: 707-708.

Sharp, R. and U.R. Sumaila (2009). Quantification of U.S. Marine Fisheries Subsidies. *North American Journal of Fisheries Management,* vol. 29:18-32.

Steenblik, R.P. and P.F. Wallis (2001). Subsidies to marine capture fisheries: the international information gap. *In: Fishing in the Dark: A Symposium on Access to Environmental Information and Government Accountability in Fishing Subsidy Programmes*, held in Brussels 28-29 November 2000, World Wildlife Fund, Endangered Seas Campaign, Washington DC, pp. 17-39.

Stone, J.R.N. (1954). Linear Expenditure Systems in Demand Analysis: an Application to the Pattern of British Demand. *Economic Journal*, 64:511-527.

Stone, C. (1997). Too many fishing boats, too few fish: can trade laws trim subsidies and restore the balance in global fisheries? *Ecology Law Quarterly*, vol. 24: 505-44.

Sumaila, U.R. (2002). Achieving sustainable fisheries: The economic dimension. Paper presented at the UNEP Workshop on Fisheries Subsidies and Sustainable Fisheries Management, 26-27 April, UNEP, Geneva.

Sumaila, U.R., Khan, A., Watson, R., Munro, G., Zeller, D., Baron, N., Pauly, D. (2007). The world trade organization and global fisheries sustainability. *Fisheries Research*, vol. 88: 1-4.

Sumaila, U.R. and D. Pauly (ed) (2006). Catching More Bait: A Bottom-up Re-estimation of Global Fisheries Subsidies. *Fisheries Centre Research Reports Volume 14 Number 6*

Sumaila, U.R., L. Teh, R. Watson, P. Tyedmers and D. Pauly (2008). Fuel Price Increase, Subsidies, Overcapacity and Resource Sustainability. *ICES Journal of Marine Science*, ICES J. Mar. Sci., 65(6): 832-840

Sumaila, U.R., A. Khan, A.J. Dyck, R.Watson, G. Munro, P. Tydemers and D. Pauly (2009). A Bottom-up Re-estimation of global fisheries subsidies. *Fisheries Centre Research Working Paper Series, no. 2009-11.*

TEEB (2009). *The Economics of Ecosystems and Biodiversity for National and International Policy Makers Summary: Responding to the Value of Nature*, 41pp.

Townsend R.E. (1990). Entry restrictions in the fishery: a survey of the evidence. *Land Economics*, 66: 359-78.

Tupper, M. H. (2002). Marine reserves and fisheries management. *Science* vol. 295, 1233.

Varian, H.R. (1992). Microeconomic Analysis, 3rd Edition, New York: W.W. Norton, 559p.

Weninger, Q., and K.E. McConnell (2000). Buyback Programs in Commercial Fisheries: Efficiency versus Transfers. *The Canadian Journal of Economics* 33(2):394–412.

World Bank Committee on Trade and Environment (2000). *Environmental Benefits of Removing Trade Restrictions and Distortions: The Fisheries Sector. Note by the Secretariat* (WT/CTE/W/167), 16 October (Geneva, WTO).

Annex

Table A1. Results of simulations on demand categories as a % change to the BAU – 2010 (SCN1 – 100 per cent subsidy removal to the primary fishing industry; SCN2 – 12 per cent annual subsidy reduction to the primary fishing sector; SCN3 – 100 per cent subsidy removal to the fish manufacturing sector; SCN4 – and 50 per cent increase of subsidies to the primary fishing sector).

Economic Activities	Private consumption				Exports				Imports				Domestic sales			
	SCN1	SCN2	SCN3	SCN4	SCN1	SCN2	SCN3	SCN4	SCN1	SCN2	SCN3	SCN4	SCN1	SCN2	SCN3	SCN4
Agriculture, hunting and forestry, logging	0.07	0.03	0.02	-0.03	0.23	0.06	0.04	-0.10	0.15	0.09	0.03	-0.07	0.26	0.10	0.05	-0.11
Fishing	-0.47	-0.19	0.19	0.19	-6.95	-2.83	1.32	3.04	8.64	3.40	-5.15	-3.42	-1.93	-0.76	-1.86	0.81
Mining and quarrying	0.41	0.18	0.05	-0.18	0.69	0.30	0.10	-0.30	-0.53	-0.31	0.14	0.24	0.53	0.21	0.14	-0.23
Production of meat and meat products	0.07	0.03	0.02	-0.03	0.24	0.10	0.05	-0.11	-0.01	0.00	0.00	0.00	0.10	0.04	0.02	-0.04
Processing of fish and fish products	-0.08	-0.03	-0.15	0.03	-3.29	-1.29	-3.82	1.38	1.67	0.65	1.86	-0.68	-0.22	-0.08	-0.32	0.09
Manufacture of dairy products	0.06	0.03	0.01	-0.03	0.30	0.12	0.04	-0.13	0.09	0.04	0.02	-0.04	0.11	0.05	0.03	-0.05
Prepared animal feeds	0.05	0.02	0.01	-0.02	0.00	0.00	0.06	0.00	0.46	0.16	0.07	-0.20	0.27	0.08	0.05	-0.12
Beverages & tobacco products	0.06	0.02	0.02	-0.03	0.11	0.04	0.05	-0.05	0.07	0.03	0.00	-0.03	0.10	0.04	0.02	-0.04
Fruits, vegetables, animal oils, grain mill, starches	0.07	0.03	0.02	-0.03	0.52	0.24	0.05	-0.22	-0.03	-0.02	-0.01	0.01	0.13	0.05	0.01	-0.06
Textiles and leather	0.12	0.05	0.03	-0.05	0.13	0.05	0.05	-0.06	0.13	0.05	0.04	-0.06	0.13	0.05	0.04	-0.06
Wood and products of wood and cork	0.16	0.05	0.04	-0.07	0.21	0.08	0.06	-0.09	0.54	0.22	0.19	-0.24	0.49	0.20	0.16	-0.21
Pulp, paper products; publishing and printing	0.19	0.08	0.04	-0.08	0.56	0.26	0.08	-0.23	0.08	0.03	-0.04	-0.04	0.17	0.07	-0.02	-0.08
Coke, refined petroleum products and nuclear fuel	0.17	0.07	0.03	-0.08	0.00	0.00	0.00	0.00	0.15	0.06	0.03	-0.07	0.15	0.06	0.03	-0.07
Chemicals and chemical products	0.17	0.07	0.03	-0.07	0.34	0.14	0.07	-0.14	0.37	0.14	0.12	-0.16	0.37	0.15	0.12	-0.16
Rubber and plastic products	0.17	0.07	0.04	-0.07	0.00	0.00	0.00	0.00	0.38	0.15	0.12	-0.16	0.38	0.15	0.12	-0.17
Other non-metallic mineral products	0.17	0.07	0.02	-0.08	0.34	0.12	0.06	-0.14	0.60	0.25	0.24	-0.26	0.62	0.24	0.21	-0.27
Basic metals and fabricated metal products	0.17	0.07	0.05	-0.07	0.09	0.04	0.05	-0.04	0.28	0.12	-0.01	-0.12	0.26	0.11	0.01	-0.12
Machinery and equipment n.e.c.	0.16	0.06	0.04	-0.07	0.00	0.00	0.00	0.00	0.82	0.34	0.28	-0.35	0.71	0.28	0.25	-0.31
Electrical and optical equipment	0.17	0.07	0.05	-0.08	0.00	0.00	0.00	0.00	0.59	0.24	0.20	-0.25	0.59	0.24	0.20	-0.25
Transport equipment	0.18	0.07	0.04	-0.08	0.00	0.00	0.00	0.00	0.45	0.18	0.15	-0.20	0.45	0.18	0.15	-0.20
Manufacturing n.e.c.	0.18	0.07	0.04	-0.08	0.00	0.00	0.00	-0.15	0.45	0.18	0.16	-0.19	0.44	0.18	0.15	-0.19
Electricity, gas, steam and hot water supply	0.24	0.11	0.05	-0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.09	0.05	-0.10
Collection, purification and distribution of water	0.27	0.12	0.05	-0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.10	0.06	-0.10
Construction	0.11	0.04	0.02	-0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.72	0.29	0.25	-0.31
Sale, maintenance, repair of motor vehicles and motorcycles	0.20	0.08	0.06	-0.09	0.20	0.09	0.05	-0.08	0.00	0.00	0.00	0.00	0.23	0.09	0.02	-0.10
Wholesale trade and commission trade, except motor vehicles	0.12	0.03	0.08	-0.05	0.07	0.00	0.06	-0.03	0.31	0.17	-0.15	-0.14	0.21	0.09	-0.03	-0.10
Retail trade, except of motor vehicles	0.20	0.08	0.06	-0.09	0.13	0.06	0.06	-0.06	-0.02	-0.02	-0.02	0.01	0.10	0.04	0.04	-0.04
Hotels and restaurants	0.13	0.06	0.01	-0.06	0.04	0.02	-0.02	-0.02	0.21	0.08	0.07	-0.09	0.14	0.06	0.02	-0.06
Land transport; transport via pipelines	0.19	0.07	0.06	-0.08	0.16	0.06	0.06	-0.07	0.16	0.07	-0.02	-0.05	0.20	0.08	0.04	-0.09
Water transport	0.70	0.21	0.03	-0.30	1.48	0.44	0.04	-0.64	-0.73	-0.17	0.09	0.32	0.63	0.21	0.08	-0.27
Air transport	0.16	0.06	0.04	-0.07	0.16	0.08	0.07	-0.07	0.08	0.03	0.01	-0.03	0.11	0.05	0.03	-0.05
Supporting transport activities; activities of travel agencies	0.16	0.06	0.06	-0.07	0.11	0.05	0.06	-0.05	0.10	0.03	-0.05	-0.05	0.14	0.05	0.02	-0.06
Post and telecommunications	0.20	0.08	0.05	-0.09	0.19	0.09	0.07	-0.08	0.09	0.03	-0.01	-0.04	0.19	0.08	0.05	-0.08
Financial intermediation, excluding insurance and pension	0.15	0.06	0.05	-0.07	0.11	0.05	0.06	-0.05	0.14	0.03	-0.01	-0.06	0.15	0.05	0.03	-0.07
Insurance and pension funding, except compulsory social security	0.19	0.08	0.04	-0.08	0.23	0.08	0.04	-0.11	0.12	0.04	0.02	-0.05	0.19	0.08	0.04	-0.08
Activities auxiliary to financial intermediation	0.16	0.06	0.04	-0.06	0.00	0.00	0.00	0.00	0.18	0.07	0.01	-0.08	0.18	0.07	0.01	-0.08
Real estate activities	-0.03	-0.07	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.05	0.06	-0.08
Renting of machinery and equipment without operator	0.07	0.03	0.05	-0.03	0.00	0.00	0.00	0.00	0.40	0.15	0.01	-0.18	0.22	0.07	0.03	-0.10
Computer and related activities; research and development	0.14	0.05	0.04	-0.06	0.02	0.00	0.03	-0.01	0.26	0.10	0.09	-0.11	0.25	0.10	0.08	-0.11
Other business activities	0.10	0.03	0.03	-0.05	0.03	-0.01	0.03	-0.01	0.44	0.19	0.12	-0.19	0.32	0.13	0.10	-0.14
Public administration and defence; compulsory social security	0.27	0.12	0.05	-0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.10	0.16	-0.09
Education	0.23	0.10	0.05	-0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.10	0.17	-0.09
Health and social work	0.23	0.10	0.03	-0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.08	0.11	-0.07
Other community, social and personal service activities	0.22	0.09	0.05	-0.10	0.23	0.11	0.07	-0.10	0.08	0.02	0.02	-0.04	0.22	0.09	0.07	-0.10

Activities of households as employers of domestic staff	0.27	0.12	0.07	-0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.12	0.07	-0.12

Table A2. Results of simulation on demand categories as a % change to the BAU – 2015 (SCN1 – 100 per cent subsidy removal to the primary fishing industry; SCN2 – 12 per cent annual subsidy reduction to the primary fishing sector; SCN3 – 100 per cent subsidy removal to the fish manufacturing sector; SCN4 – and 50 per cent increase of subsidies to the primary

Economic Activities	Private consumption				Exports				Imports				Domestic sales			
	SCN1	SCN2	SCN3	SCN4	SCN1	SCN2	SCN3	SCN4	SCN1	SCN2	SCN3	SCN4	SCN1	SCN2	SCN3	SCN4
Agriculture, hunting and forestry, logging	0.10	0.06	0.03	-0.05	0.46	0.20	0.10	-0.20	0.08	0.14	0.02	-0.04	0.37	0.24	0.08	-0.16
Fishing	-0.56	-0.41	0.18	0.23	-8.47	-6.20	0.95	3.78	10.58	7.66	-4.88	-4.17	-2.44	-1.72	-2.03	1.03
Mining and quarrying	0.48	0.40	0.08	-0.20	0.84	0.63	0.15	-0.36	-0.29	-0.48	0.23	0.15	0.73	0.48	0.20	-0.32
Production of meat and meat products	0.09	0.06	0.03	-0.04	0.33	0.22	0.07	-0.14	-0.01	-0.01	0.01	0.01	0.13	0.09	0.04	-0.06
Processing of fish and fish products	-0.10	-0.07	-0.15	0.04	-4.18	-2.93	-4.14	1.77	2.13	1.49	2.03	-0.88	-0.28	-0.19	-0.33	0.11
Manufacture of dairy products	0.09	0.06	0.02	-0.04	0.41	0.27	0.07	-0.18	0.12	0.08	0.03	-0.05	0.15	0.10	0.04	-0.07
Prepared animal feeds	0.08	0.05	0.02	-0.03	0.10	0.00	0.00	-0.05	0.59	0.39	0.10	-0.26	0.45	0.24	0.09	-0.20
Beverages & tobacco products	0.09	0.06	0.03	-0.04	0.18	0.10	0.08	-0.08	0.09	0.06	0.01	-0.04	0.14	0.09	0.04	-0.06
Fruits, vegetables, animal oils, grain mill, starches	0.10	0.07	0.03	-0.04	0.55	0.47	0.05	-0.24	0.01	-0.03	0.01	-0.01	0.18	0.12	0.02	-0.08
Textiles and leather	0.18	0.11	0.05	-0.08	0.21	0.12	0.08	-0.09	0.18	0.12	0.06	-0.08	0.19	0.12	0.06	-0.08
Wood and products of wood and cork	0.23	0.16	0.08	-0.09	0.29	0.19	0.09	-0.13	0.69	0.49	0.25	-0.30	0.65	0.44	0.22	-0.28
Pulp, paper products; publishing and printing	0.25	0.17	0.07	-0.11	0.59	0.49	0.07	-0.26	0.15	0.07	-0.01	-0.07	0.25	0.16	0.00	-0.11
Coke, refined petroleum products and nuclear fuel	0.23	0.16	0.06	-0.10	0.00	0.00	0.00	0.00	0.23	0.14	0.05	-0.10	0.23	0.14	0.05	-0.10
Chemicals and chemical products	0.23	0.15	0.06	-0.10	0.42	0.30	0.09	-0.18	0.50	0.33	0.17	-0.22	0.51	0.34	0.17	-0.22
Rubber and plastic products	0.23	0.15	0.06	-0.10	0.00	0.00	0.00	0.00	0.50	0.34	0.17	-0.22	0.51	0.35	0.17	-0.22
Other non-metallic mineral products	0.25	0.16	0.05	-0.11	0.54	0.30	0.10	-0.23	0.73	0.54	0.32	-0.32	0.82	0.56	0.29	-0.36
Basic metals and fabricated metal products	0.24	0.16	0.08	-0.10	0.15	0.08	0.07	-0.07	0.37	0.26	0.03	-0.16	0.36	0.24	0.05	-0.16
Machinery and equipment n.e.c.	0.23	0.15	0.07	-0.10	0.00	0.00	0.00	0.00	1.03	0.74	0.37	-0.45	0.93	0.64	0.34	-0.40
Electrical and optical equipment	0.24	0.16	0.08	-0.11	0.00	0.00	0.00	0.00	0.77	0.53	0.28	-0.33	0.77	0.53	0.28	-0.33
Transport equipment	0.25	0.17	0.07	-0.11	0.00	0.00	0.00	0.00	0.60	0.41	0.21	-0.26	0.60	0.41	0.21	-0.26
Manufacturing n.e.c.	0.25	0.16	0.07	-0.11	0.26	0.13	0.13	0.00	0.58	0.41	0.21	-0.25	0.58	0.40	0.21	-0.25
Electricity, gas, steam and hot water supply	0.27	0.22	0.07	-0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.20	0.07	-0.12
Collection, purification and distribution of water	0.30	0.25	0.07	-0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.21	0.08	-0.12
Construction	0.17	0.10	0.04	-0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.94	0.65	0.35	-0.41
Sale, maintenance, repair of motor vehicles and motorcycles	0.26	0.18	0.08	-0.12	0.24	0.18	0.07	-0.11	0.64	0.64	0.00	0.00	0.32	0.21	0.06	-0.14
Wholesale trade and commission trade, except motor vehicles	0.24	0.10	0.11	-0.10	0.19	0.05	0.07	-0.08	0.27	0.29	-0.10	-0.12	0.29	0.20	0.00	-0.13
Retail trade, except of motor vehicles	0.28	0.19	0.10	-0.12	0.17	0.13	0.08	-0.08	0.00	-0.02	-0.02	0.00	0.14	0.09	0.06	-0.06
Hotels and restaurants	0.19	0.12	0.04	-0.08	0.04	0.04	-0.02	-0.02	0.30	0.19	0.11	-0.13	0.20	0.13	0.04	-0.09
Land transport; transport via pipelines	0.26	0.17	0.09	-0.12	0.23	0.14	0.09	-0.10	0.17	0.12	-0.02	-0.08	0.27	0.18	0.06	-0.12
Water transport	1.15	0.62	0.08	-0.49	2.47	1.29	0.11	-1.06	-1.35	-0.63	0.10	0.60	0.96	0.56	0.14	-0.42
Air transport	0.22	0.14	0.07	-0.10	0.17	0.15	0.08	-0.07	0.12	0.07	0.03	-0.05	0.15	0.10	0.05	-0.07
Supporting transport activities; activities of travel agencies	0.23	0.15	0.10	-0.10	0.17	0.11	0.09	-0.07	0.15	0.08	-0.06	-0.07	0.21	0.13	0.04	-0.09
Post and telecommunications	0.25	0.18	0.08	-0.11	0.22	0.17	0.08	-0.10	0.16	0.08	0.02	-0.07	0.25	0.18	0.07	-0.11
Financial intermediation, excluding insurance and pension	0.22	0.14	0.09	-0.10	0.15	0.10	0.08	-0.07	0.26	0.12	0.02	-0.11	0.26	0.14	0.07	-0.11
Insurance and pension funding, except compulsory social security	0.25	0.17	0.07	-0.11	0.26	0.20	0.07	-0.10	0.19	0.11	0.05	-0.09	0.26	0.18	0.07	-0.11
Activities auxiliary to financial intermediation	0.22	0.14	0.06	-0.10	0.00	0.00	0.00	0.00	0.26	0.17	0.04	-0.11	0.26	0.17	0.04	-0.11
Real estate activities	0.20	-0.04	0.08	-0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.16	0.13	-0.16
Renting of machinery and equipment without operator	0.14	0.07	0.08	-0.06	0.00	0.00	0.00	0.00	0.54	0.35	0.02	-0.24	0.36	0.20	0.07	-0.16
Computer and related activities; research and development	0.21	0.13	0.07	-0.10	0.10	0.02	0.08	-0.04	0.35	0.23	0.12	-0.15	0.34	0.23	0.12	-0.15
Other business activities	0.18	0.10	0.06	-0.08	0.13	0.03	0.08	-0.06	0.53	0.40	0.15	-0.23	0.43	0.29	0.15	-0.19
Public administration and defence; compulsory social security	0.31	0.25	0.07	-0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.19	0.17	-0.09
Education	0.25	0.21	0.07	-0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.19	0.17	-0.08
Health and social work	0.27	0.21	0.05	-0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.15	0.12	-0.08
Other community, social and personal service activities	0.27	0.20	0.07	-0.12	0.24	0.21	0.07	-0.10	0.16	0.07	0.06	-0.07	0.27	0.20	0.09	-0.12
Activities of households as employers of domestic staff	0.28	0.24	0.07	-0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.24	0.07	-0.12

fishing sector).

Table A3. Results of simulations on production categories as a % change to the BAU – 2010 (SCN1 – 100 per cent subsidy removal to the primary fishing industry; SCN2 – 12 per cent annual subsidy reduction to the primary fishing sector; SCN3 – 100 per cent subsidy removal to the fish manufacturing sector; SCN4 – and 50 per cent increase of subsidies to the primary fishing sector).

Economic Activities	Value added				Employment				Capital Stock				Domestic production			
	SCN1	SCN2	SCN3	SCN4	SCN1	SCN2	SCN3	SCN4	SCN1	SCN2	SCN3	SCN4	SCN1	SCN2	SCN3	SCN4
Agriculture, hunting and forestry, logging	0.28	0.09	0.05	-0.12	1.33	0.00	0.00	0.00	0.22	0.05	0.05	-0.09	0.28	0.09	0.05	-0.12
Fishing	-3.55	-1.42	-0.90	1.52	-6.02	-2.41	-1.20	2.41	-1.60	-0.39	-0.39	0.72	-3.55	-1.42	-0.90	1.52
Mining and quarrying	0.58	0.24	0.13	-0.25	0.00	0.00	0.00	0.00	0.20	0.05	0.07	-0.09	0.58	0.23	0.13	-0.25
Production of meat and meat products	0.24	0.10	0.05	-0.10	0.00	0.00	0.00	0.00	0.09	0.02	0.04	-0.04	0.24	0.10	0.05	-0.10
Processing of fish and fish products	-2.98	-1.16	-3.47	1.24	0.00	0.00	-14.29	0.00	-0.83	-0.19	-1.10	0.35	-2.98	-1.16	-3.47	1.24
Manufacture of dairy products	0.30	0.12	0.04	-0.13	0.00	0.00	0.00	0.00	0.12	0.03	0.04	-0.05	0.30	0.12	0.04	-0.13
Prepared animal feeds	0.23	0.07	0.04	-0.10	0.00	0.00	0.00	0.00	0.15	0.03	0.04	-0.06	0.23	0.07	0.04	-0.10
Beverages & tobacco products	0.13	0.05	0.05	-0.06	0.00	0.00	0.00	0.00	0.07	0.02	0.04	-0.03	0.13	0.05	0.05	-0.06
Fruits, vegetables, animal oils, grain mill, starches	0.50	0.22	0.05	-0.22	0.00	0.00	0.00	0.00	0.15	0.03	0.04	-0.07	0.50	0.22	0.05	-0.22
Textiles and leather	0.16	0.06	0.06	-0.07	0.00	0.00	0.00	0.00	0.10	0.02	0.05	-0.04	0.16	0.06	0.06	-0.07
Wood and products of wood and cork	0.42	0.17	0.13	-0.18	0.00	0.00	0.00	0.00	0.15	0.03	0.07	-0.07	0.42	0.17	0.13	-0.18
Pulp, paper products; publishing and printing	0.60	0.26	0.07	-0.26	0.00	0.00	0.00	0.00	0.19	0.04	0.05	-0.08	0.60	0.26	0.07	-0.26
Coke, refined petroleum products and nuclear fuel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chemicals and chemical products	0.50	0.20	0.12	-0.21	0.00	0.00	0.00	0.00	0.17	0.04	0.06	-0.08	0.50	0.21	0.12	-0.22
Rubber and plastic products	0.43	0.18	0.15	-0.18	0.00	0.00	0.00	0.00	0.14	0.03	0.07	-0.06	0.42	0.17	0.14	-0.18
Other non-metallic mineral products	0.63	0.24	0.17	-0.27	0.00	0.00	0.00	0.00	0.23	0.05	0.08	-0.10	0.63	0.24	0.17	-0.27
Basic metals and fabricated metal products	0.22	0.09	0.05	-0.10	0.00	0.00	0.00	0.00	0.10	0.02	0.04	-0.05	0.22	0.09	0.05	-0.10
Machinery and equipment n.e.c.	0.41	0.14	0.16	-0.17	0.00	0.00	0.00	0.00	0.22	0.05	0.10	-0.09	0.41	0.14	0.16	-0.17
Electrical and optical equipment	0.64	0.26	0.25	-0.27	0.00	0.00	0.00	0.00	0.18	0.04	0.10	-0.08	0.63	0.26	0.25	-0.27
Transport equipment	0.48	0.19	0.17	-0.21	0.00	0.00	0.00	0.00	0.14	0.03	0.08	-0.06	0.48	0.19	0.18	-0.21
Manufacturing n.e.c.	0.29	0.11	0.11	-0.13	0.00	0.00	0.00	0.00	0.13	0.03	0.07	-0.06	0.29	0.11	0.11	-0.13
Electricity, gas, steam and hot water supply	0.22	0.09	0.05	-0.10	2.50	0.00	0.00	0.00	0.08	0.02	0.04	-0.03	0.22	0.09	0.05	-0.10
Collection, purification and distribution of water	0.23	0.10	0.06	-0.10	0.00	0.00	0.00	0.00	0.08	0.02	0.04	-0.03	0.23	0.10	0.06	-0.10
Construction	0.72	0.29	0.25	-0.31	0.95	0.47	0.47	-0.47	0.23	0.05	0.10	-0.10	0.72	0.29	0.25	-0.31
Sale, maintenance, repair of motor vehicles and motorcycles	0.23	0.09	0.02	-0.10	0.00	0.00	0.00	0.00	0.08	0.02	0.03	-0.04	0.23	0.09	0.02	-0.10
Wholesale trade and commission trade, except of motor vehicles	0.21	0.08	-0.03	-0.09	0.00	0.00	0.00	0.00	0.13	0.03	0.00	-0.06	0.21	0.08	-0.03	-0.09
Retail trade, except of motor vehicles and motorcycles	0.10	0.04	0.04	-0.04	0.00	0.00	0.00	0.00	0.05	0.01	0.04	-0.02	0.10	0.04	0.04	-0.04
Hotels and restaurants	0.13	0.05	0.02	-0.06	1.75	0.00	0.00	0.00	0.05	0.01	0.03	-0.02	0.13	0.05	0.02	-0.06
Land transport; transport via pipelines	0.20	0.08	0.04	-0.09	0.00	0.00	0.00	0.00	0.10	0.02	0.04	-0.04	0.20	0.08	0.04	-0.09
Water transport	1.10	0.34	0.06	-0.48	0.00	0.00	0.00	0.00	0.85	0.20	0.06	-0.36	1.10	0.34	0.07	-0.48
Air transport	0.16	0.08	0.07	-0.07	0.00	0.00	0.00	0.00	0.07	0.02	0.05	-0.03	0.16	0.08	0.07	-0.07
Supporting transport activities; activities of travel agencies	0.14	0.05	0.03	-0.06	0.00	0.00	0.00	0.00	0.07	0.02	0.04	-0.03	0.14	0.05	0.03	-0.06
Post and telecommunications	0.20	0.08	0.05	-0.09	0.00	0.00	0.00	0.00	0.08	0.02	0.04	-0.04	0.20	0.08	0.05	-0.09
Financial intermediation, excluding insurance and pension	0.16	0.05	0.04	-0.07	0.00	0.00	0.00	0.00	0.07	0.01	0.04	-0.03	0.16	0.05	0.04	-0.07
Insurance and pension funding, except compulsory social security	0.24	0.10	0.06	-0.11	0.00	0.00	0.00	0.00	0.09	0.02	0.04	-0.04	0.24	0.10	0.06	-0.11
Activities auxiliary to financial intermediation	0.14	0.07	0.07	-0.03	0.00	0.00	0.00	0.00	0.07	0.02	0.03	-0.03	0.13	0.04	0.03	-0.06
Real estate activities	0.19	0.05	0.06	-0.08	0.00	0.00	0.00	0.00	0.19	0.04	0.06	-0.08	0.19	0.05	0.06	-0.08
Renting of machinery and equipment without operator	0.12	0.03	0.04	-0.05	0.00	0.00	0.00	0.00	0.09	0.02	0.04	-0.04	0.12	0.03	0.05	-0.05
Computer and related activities; research and development	0.09	0.03	0.05	-0.04	0.00	0.00	0.00	0.00	0.07	0.02	0.05	-0.03	0.09	0.03	0.05	-0.04
Other business activities	0.24	0.09	0.08	-0.10	0.00	0.00	0.00	0.00	0.13	0.03	0.06	-0.06	0.24	0.09	0.08	-0.10
Public administration and defence; compulsory social security	0.20	0.10	0.16	-0.09	0.00	0.00	0.00	-0.60	0.08	0.02	0.08	-0.04	0.20	0.10	0.16	-0.09
Education	0.21	0.10	0.17	-0.09	0.00	0.00	0.00	0.00	0.08	0.02	0.08	-0.04	0.21	0.10	0.17	-0.09
Health and social work	0.17	0.08	0.11	-0.07	0.00	0.00	0.00	-1.32	0.07	0.02	0.06	-0.03	0.17	0.08	0.11	-0.07
Other community, social and personal service activities	0.23	0.10	0.07	-0.10	0.00	0.00	0.00	0.00	0.08	0.02	0.05	-0.03	0.23	0.10	0.07	-0.10

Activities of households as employers of domestic staff	0.27	0.12	0.07	-0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.12	0.07	-0.12

Table A4. Results of simulations on production categories as a % change to the BAU – 2015 (SCN1 – 100 per cent subsidy removal to the primary fishing industry; SCN2 – 12 per cent annual subsidy reduction to the primary fishing sector; SCN3 – 100 per cent subsidy removal to the fish manufacturing sector; SCN4 – and 50 per cent increase of subsidies to the primary fishing sector).

Economic Activities	Value added				Employment				Capital Stock				Domestic production			
	SCN1	SCN2	SCN3	SCN4	SCN1	SCN2	SCN3	SCN4	SCN1	SCN2	SCN3	SCN4	SCN1	SCN2	SCN3	SCN4
Agriculture, hunting and forestry, logging	0.48	0.25	0.10	-0.21	0.00	0.00	0.00	-1.16	0.43	0.19	0.10	-0.19	0.48	0.25	0.10	-0.21
Fishing	-4.38	-3.16	-1.14	1.91	-6.32	-5.26	-2.11	3.16	-2.83	-1.36	-0.70	1.26	-4.38	-3.16	-1.14	1.91
Mining and quarrying	0.77	0.53	0.19	-0.33	0.00	0.00	0.00	0.00	0.44	0.18	0.15	-0.19	0.77	0.53	0.19	-0.33
Production of meat and meat products	0.32	0.22	0.07	-0.14	0.00	0.00	0.00	0.00	0.22	0.09	0.09	-0.10	0.32	0.22	0.07	-0.14
Processing of fish and fish products	-3.78	-2.64	-3.76	1.59	-12.50	-12.50	-12.50	0.00	-1.63	-0.71	-1.91	0.69	-3.78	-2.64	-3.76	1.59
Manufacture of dairy products	0.41	0.27	0.07	-0.18	0.00	0.00	0.00	0.00	0.27	0.11	0.09	-0.12	0.41	0.27	0.07	-0.18
Prepared animal feeds	0.43	0.21	0.09	-0.19	0.00	0.00	0.00	0.00	0.36	0.14	0.10	-0.15	0.43	0.21	0.09	-0.19
Beverages & tobacco products	0.20	0.12	0.09	-0.09	0.00	0.00	0.00	0.00	0.17	0.07	0.10	-0.08	0.20	0.12	0.09	-0.09
Fruits, vegetables, animal oils, grain mill, starches	0.56	0.45	0.06	-0.24	0.00	0.00	0.00	0.00	0.32	0.14	0.09	-0.14	0.56	0.45	0.06	-0.24
Textiles and leather	0.26	0.15	0.10	-0.11	0.00	0.00	0.00	0.00	0.22	0.09	0.10	-0.10	0.26	0.15	0.10	-0.11
Wood and products of wood and cork	0.56	0.38	0.19	-0.24	0.00	0.00	0.00	0.00	0.34	0.14	0.15	-0.15	0.56	0.38	0.19	-0.24
Pulp, paper products; publishing and printing	0.69	0.54	0.08	-0.30	0.00	0.00	0.00	0.00	0.40	0.17	0.10	-0.17	0.69	0.54	0.08	-0.30
Coke, refined petroleum products and nuclear fuel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chemicals and chemical products	0.65	0.46	0.18	-0.27	0.00	0.00	0.00	0.00	0.38	0.16	0.14	-0.16	0.64	0.45	0.17	-0.28
Rubber and plastic products	0.57	0.38	0.19	-0.24	0.00	0.00	0.00	0.00	0.32	0.13	0.15	-0.14	0.56	0.38	0.19	-0.24
Other non-metallic mineral products	0.89	0.57	0.26	-0.39	0.00	0.00	0.00	0.00	0.51	0.21	0.18	-0.22	0.89	0.57	0.25	-0.39
Basic metals and fabricated metal products	0.33	0.21	0.09	-0.14	0.00	0.00	0.00	0.00	0.24	0.10	0.09	-0.10	0.33	0.21	0.09	-0.14
Machinery and equipment n.e.c.	0.65	0.37	0.26	-0.28	0.00	0.00	0.00	0.00	0.47	0.20	0.21	-0.20	0.65	0.37	0.26	-0.28
Electrical and optical equipment	0.80	0.57	0.31	-0.34	0.00	0.00	0.00	0.00	0.40	0.16	0.19	-0.17	0.80	0.57	0.31	-0.35
Transport equipment	0.62	0.44	0.23	-0.28	0.00	0.00	0.00	0.00	0.33	0.14	0.16	-0.14	0.62	0.43	0.23	-0.27
Manufacturing n.e.c.	0.44	0.27	0.18	-0.19	0.00	0.00	0.00	0.00	0.30	0.12	0.15	-0.13	0.43	0.27	0.17	-0.19
Electricity, gas, steam and hot water supply	0.28	0.20	0.07	-0.12	0.00	0.00	0.00	0.00	0.19	0.07	0.09	-0.08	0.28	0.20	0.07	-0.12
Collection, purification and distribution of water	0.28	0.21	0.08	-0.12	0.00	0.00	0.00	0.00	0.19	0.07	0.10	-0.08	0.28	0.21	0.08	-0.12
Construction	0.94	0.65	0.35	-0.41	1.24	0.83	0.41	-0.41	0.50	0.21	0.21	-0.21	0.94	0.65	0.35	-0.41
Sale, maintenance, repair of motor vehicles and motorcycles	0.31	0.21	0.06	-0.14	3.45	3.45	0.00	0.00	0.21	0.08	0.08	-0.09	0.31	0.21	0.06	-0.14
Wholesale trade and commission trade, except of motor vehicles	0.29	0.19	0.00	-0.13	0.00	0.00	0.00	0.00	0.26	0.12	0.03	-0.12	0.29	0.19	0.00	-0.13
Retail trade, except of motor vehicles and motorcycles	0.14	0.09	0.06	-0.06	0.86	0.86	0.00	0.00	0.14	0.05	0.09	-0.06	0.14	0.09	0.06	-0.06
Hotels and restaurants	0.18	0.12	0.03	-0.08	0.00	0.00	0.00	0.00	0.14	0.05	0.08	-0.06	0.18	0.12	0.03	-0.08
Land transport; transport via pipelines	0.27	0.18	0.07	-0.12	0.00	0.00	0.00	0.00	0.22	0.09	0.09	-0.10	0.27	0.18	0.07	-0.12
Water transport	1.79	0.97	0.13	-0.77	0.00	0.00	0.00	0.00	1.59	0.73	0.12	-0.68	1.79	0.97	0.13	-0.77
Air transport	0.18	0.15	0.08	-0.08	3.12	3.12	3.12	0.00	0.17	0.07	0.10	-0.07	0.18	0.15	0.08	-0.08
Supporting transport activities; activities of travel agencies	0.21	0.13	0.05	-0.09	5.88	5.88	0.00	0.00	0.18	0.07	0.08	-0.08	0.21	0.13	0.05	-0.09
Post and telecommunications	0.26	0.18	0.08	-0.11	0.00	0.00	0.00	0.00	0.19	0.08	0.10	-0.08	0.26	0.18	0.08	-0.11
Financial intermediation, excluding insurance and pension	0.25	0.14	0.08	-0.11	0.00	0.00	0.00	-3.70	0.19	0.07	0.09	-0.08	0.25	0.14	0.08	-0.11
Insurance and pension funding, except compulsory social security	0.30	0.22	0.08	-0.13	0.00	0.00	0.00	0.00	0.20	0.08	0.10	-0.09	0.30	0.22	0.08	-0.13
Activities auxiliary to financial intermediation	0.24	0.12	0.09	-0.12	0.00	0.00	0.00	0.00	0.19	0.07	0.09	-0.08	0.26	0.14	0.09	-0.10
Real estate activities	0.36	0.16	0.13	-0.16	0.00	0.00	0.00	0.00	0.36	0.16	0.13	-0.16	0.36	0.16	0.13	-0.16
Renting of machinery and equipment without operator	0.26	0.12	0.10	-0.11	0.00	0.00	0.00	0.00	0.23	0.09	0.10	-0.10	0.26	0.12	0.09	-0.11
Computer and related activities; research and development	0.19	0.09	0.11	-0.09	0.00	0.00	0.00	0.00	0.18	0.07	0.11	-0.08	0.19	0.09	0.11	-0.08
Other business activities	0.36	0.22	0.14	-0.16	7.14	7.14	0.00	0.00	0.29	0.12	0.13	-0.12	0.36	0.22	0.14	-0.16
Public administration and defence; compulsory social security	0.20	0.19	0.17	-0.09	0.53	0.53	0.53	0.00	0.18	0.07	0.15	-0.08	0.20	0.19	0.17	-0.09
Education	0.19	0.19	0.17	-0.08	0.99	0.99	0.99	0.00	0.18	0.07	0.15	-0.08	0.19	0.19	0.17	-0.08
Health and social work	0.18	0.15	0.12	-0.08	0.00	0.00	0.00	0.00	0.16	0.07	0.12	-0.07	0.18	0.15	0.12	-0.08

Other community, social and personal service activities	0.28	0.21	0.09	-0.12	0.00	0.00	0.00	0.00	0.19	0.07	0.10	-0.08	0.28	0.21	0.09	-0.12
Activities of households as employers of domestic staff	0.28	0.24	0.07	-0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.24	0.07	-0.12